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Developing an Adaptable NextGen Interface for the UAS Ground Control Station

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NASA Aeronautics Research Mission Directorate (ARMD)
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Outline

- Innovation
- Development Partners
- Technical Approach
- Impact of the Innovation
- Results
- Distribution/Dissemination
- Next steps

Innovation

- Motivation: NextGen traffic infrastructure is in place to support manned aircraft operations. However, the UAS ground control station (GCS) adds a data interface requirement that is not yet fully accounted for in the NextGen data service architecture
  - Existing NextGen data service is focused on aircraft, not GCS
  - Smaller UAS may not have payload or power capacity to support additional equipment

- Innovation: Provide a mechanism for a UAS—regardless of size, payload, bandwidth, and power capacity—to gain access to NextGen data-sourced traffic information in real-time

Partners

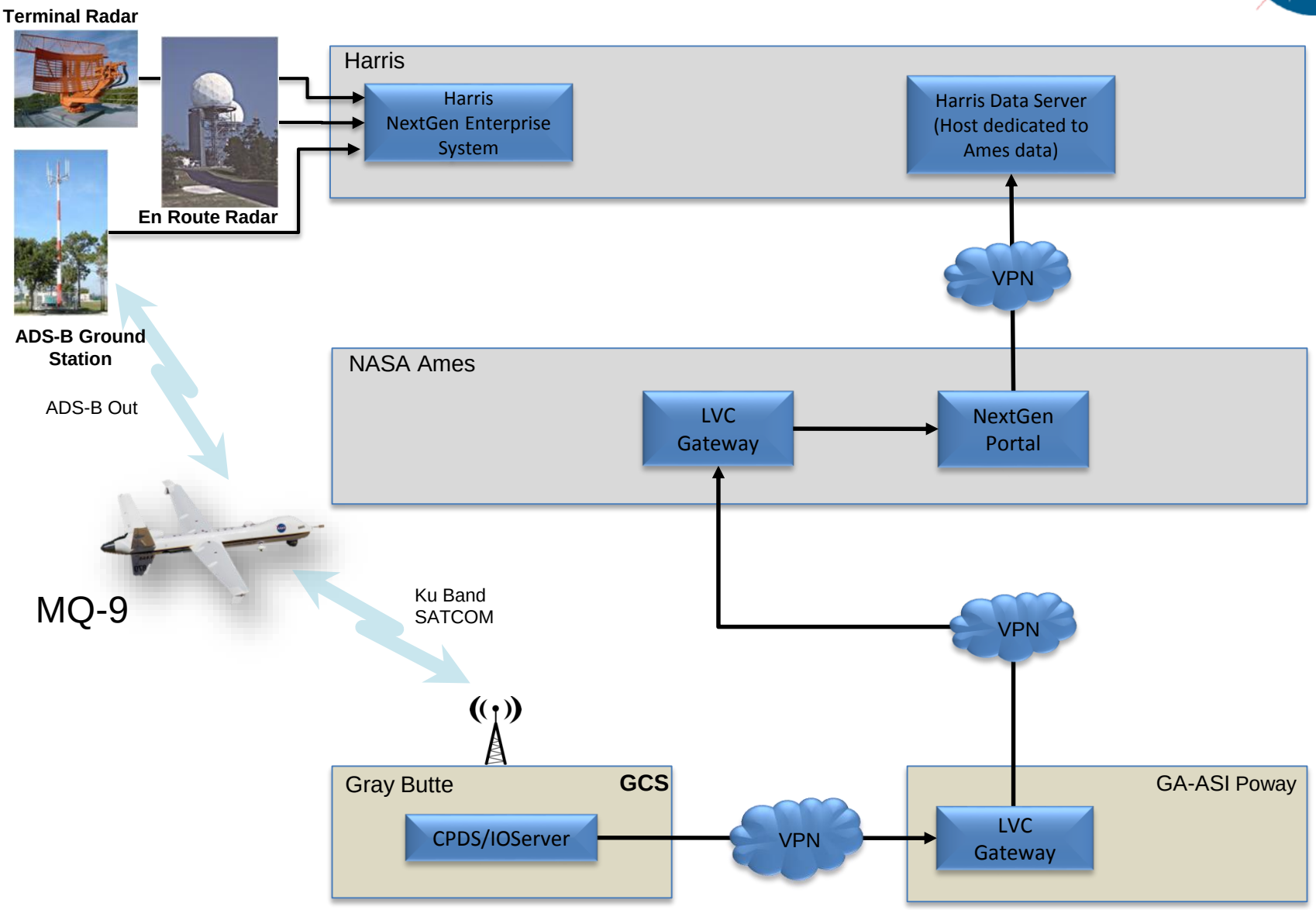
UAS Integration into the NAS

Sensor Integrated Environmental Remote Research Aircraft (SIERRA)

Technical Approach

- Leverage NASA's Live, Virtual, Constructive (LVC) flight test infrastructure to prototype a real-time connection between a UAS and the Harris Commercial NextGen traffic data service and Symphony Suite
  - Provide the location of the UAS to NextGen
  - Provide display of aircraft in the airspace around the UAS to the GCS

Technical Approach: Data Collection



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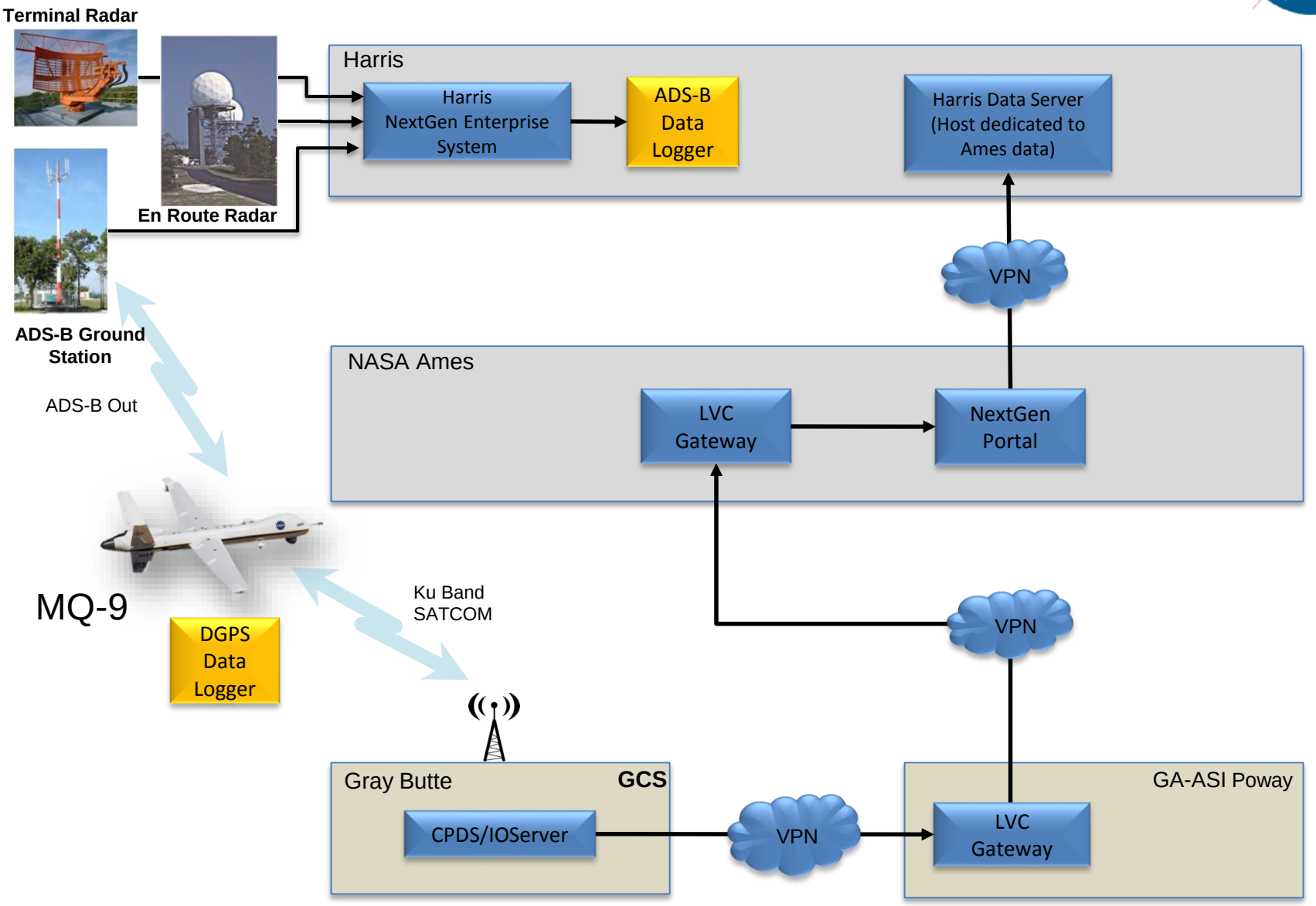

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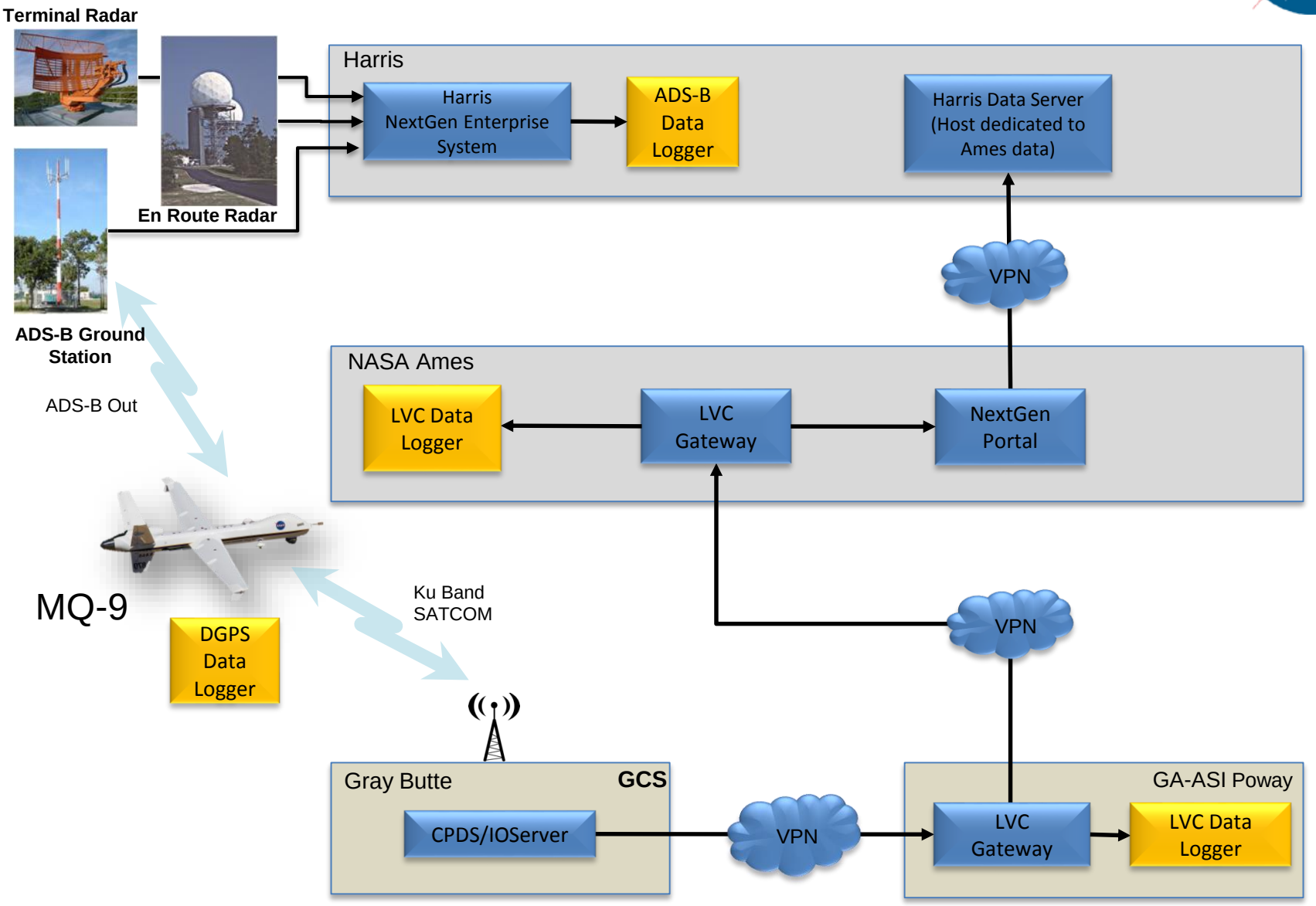

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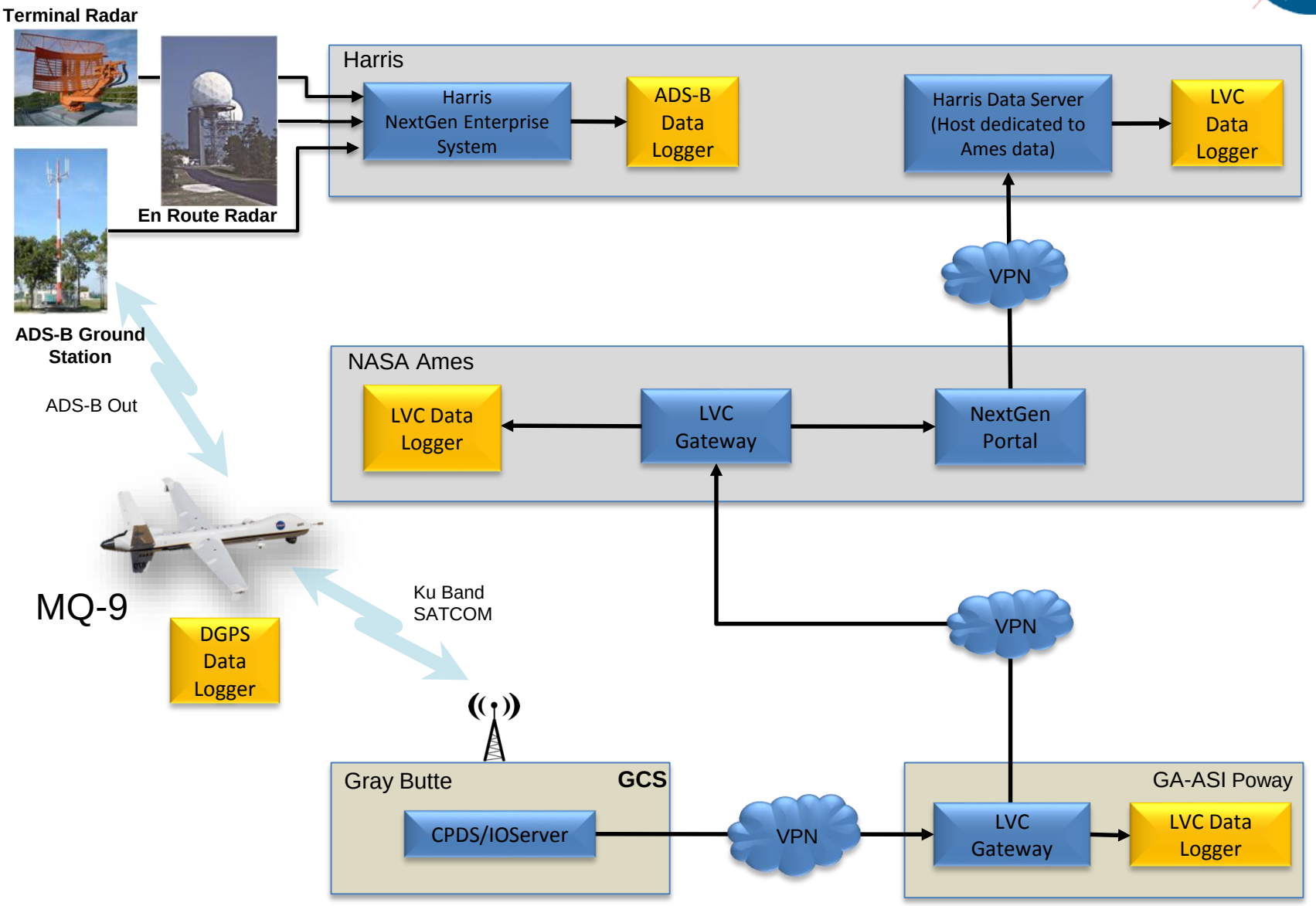
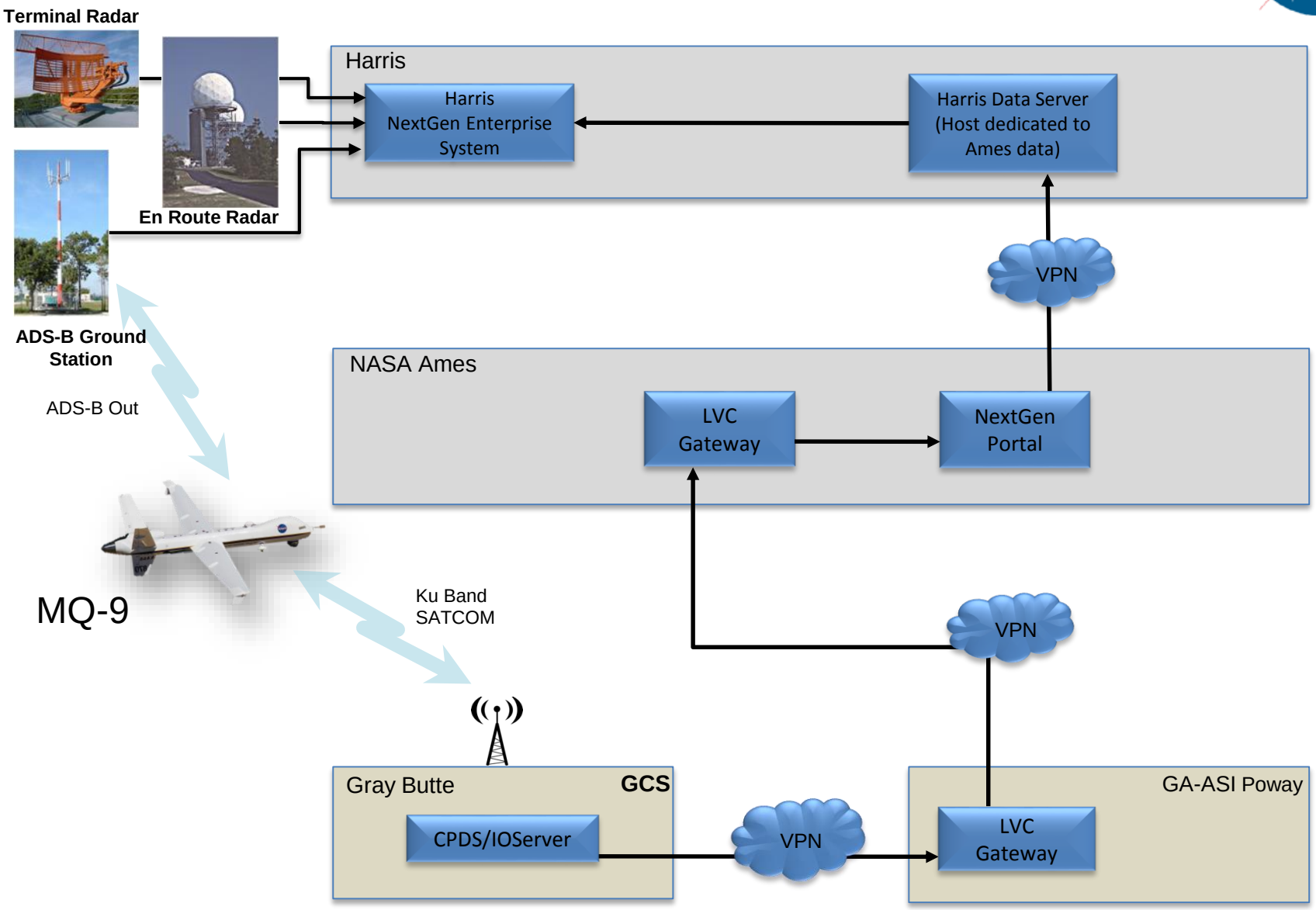


Technical Approach: Display



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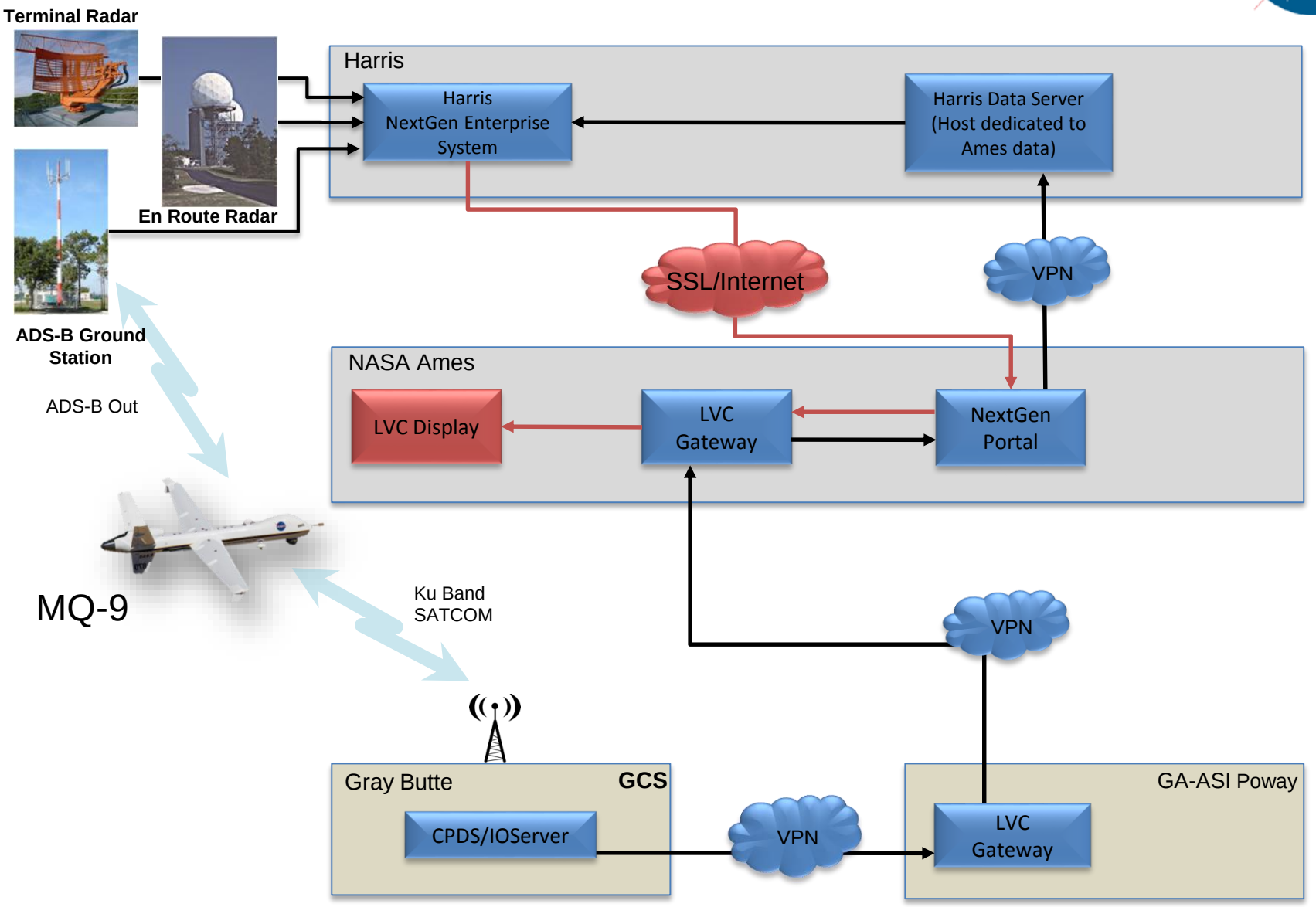

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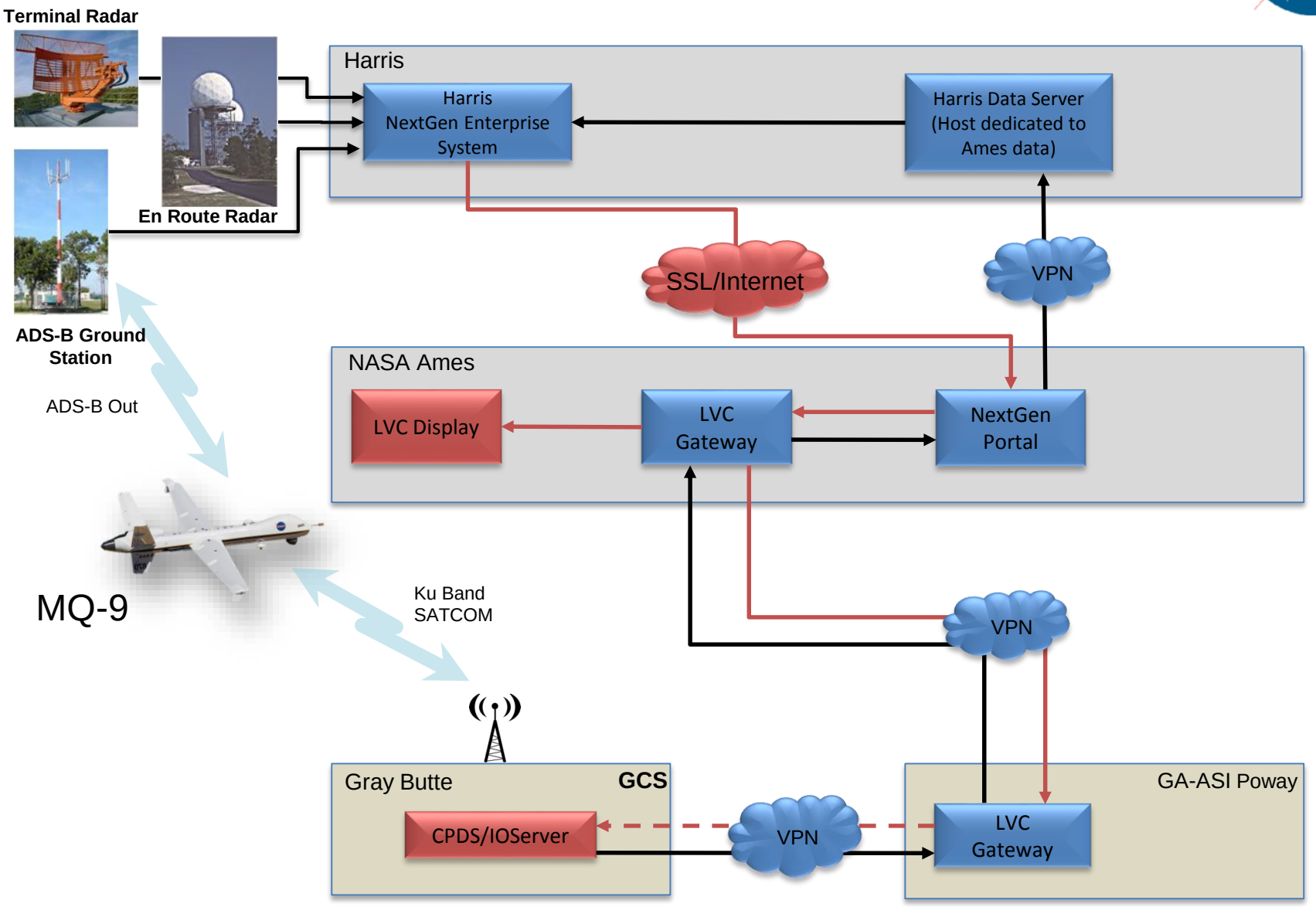
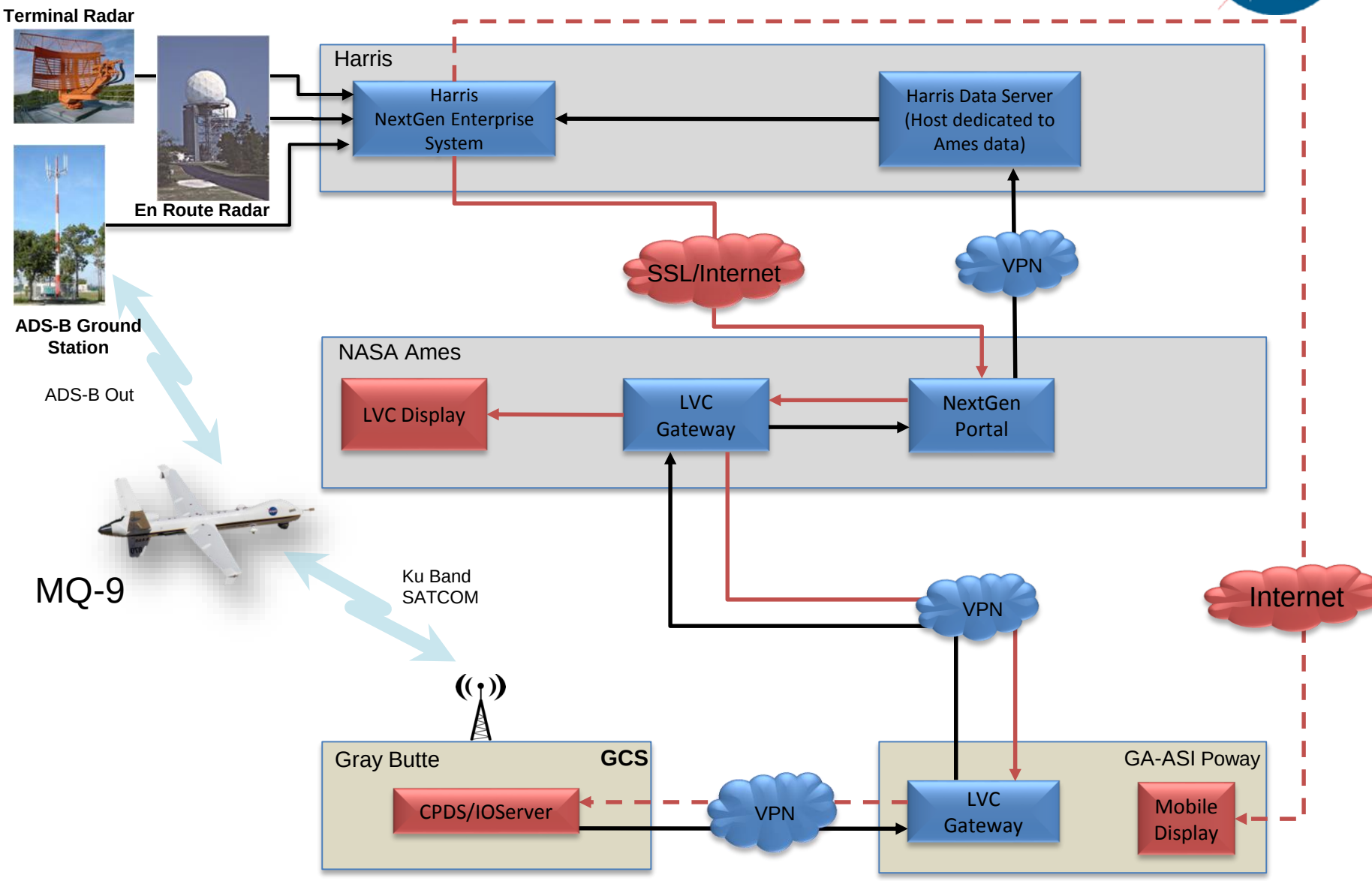


Technical Approach: Display



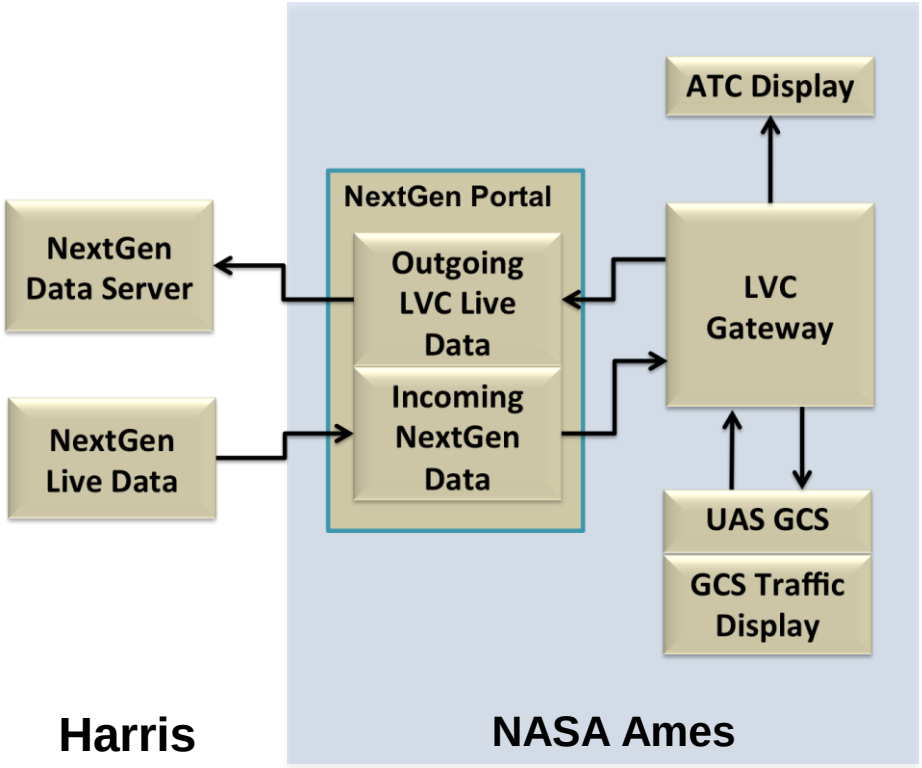
Impact of Innovation

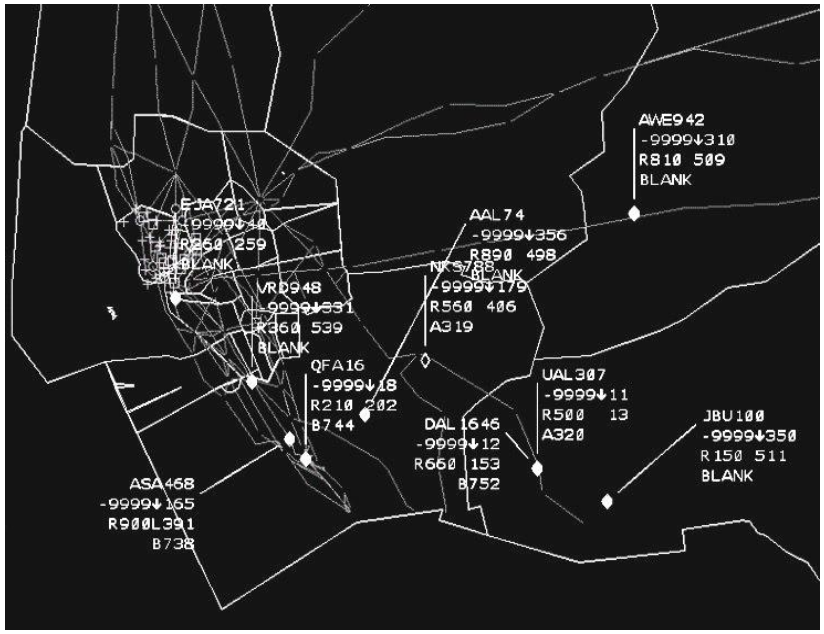
- Provide a low bandwidth, low power, and small form factor option for small and very small UAS such that operators can install surveillance equipment on their aircraft and effectively "participate" in the national airspace system (NAS)
- Add redundancy to existing traffic situation awareness capabilities for larger (well equipped) UAS
- Provide primary or alternate source of surveillance data to the NAS for UAS aircraft
- Enable ingestion of live traffic surveillance data into an LVC test environment

Result: Improved traffic awareness for all equipped aircraft operating in the NAS

Results: Harris-LVC Connection

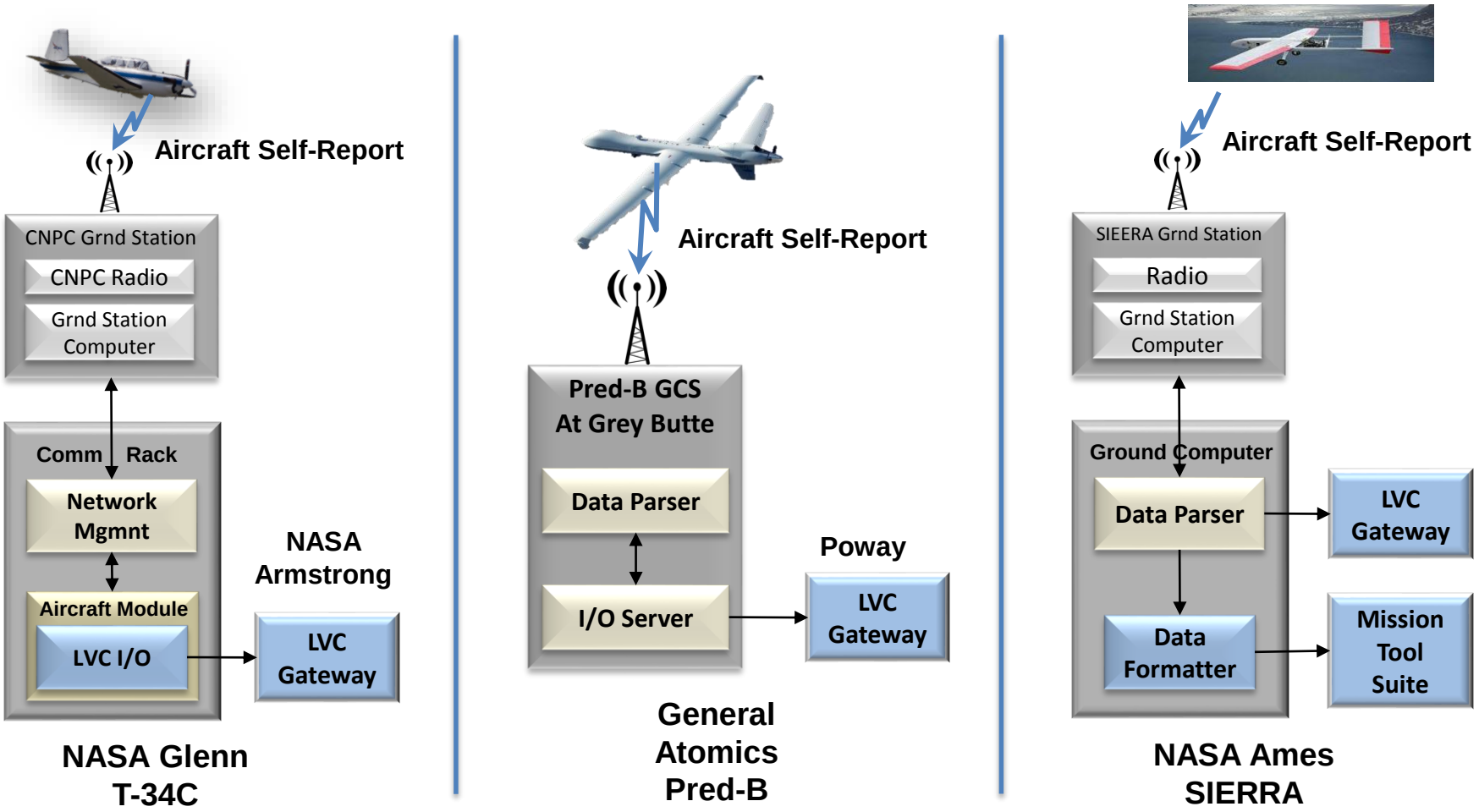
NASA LVC and Harris two-way connection





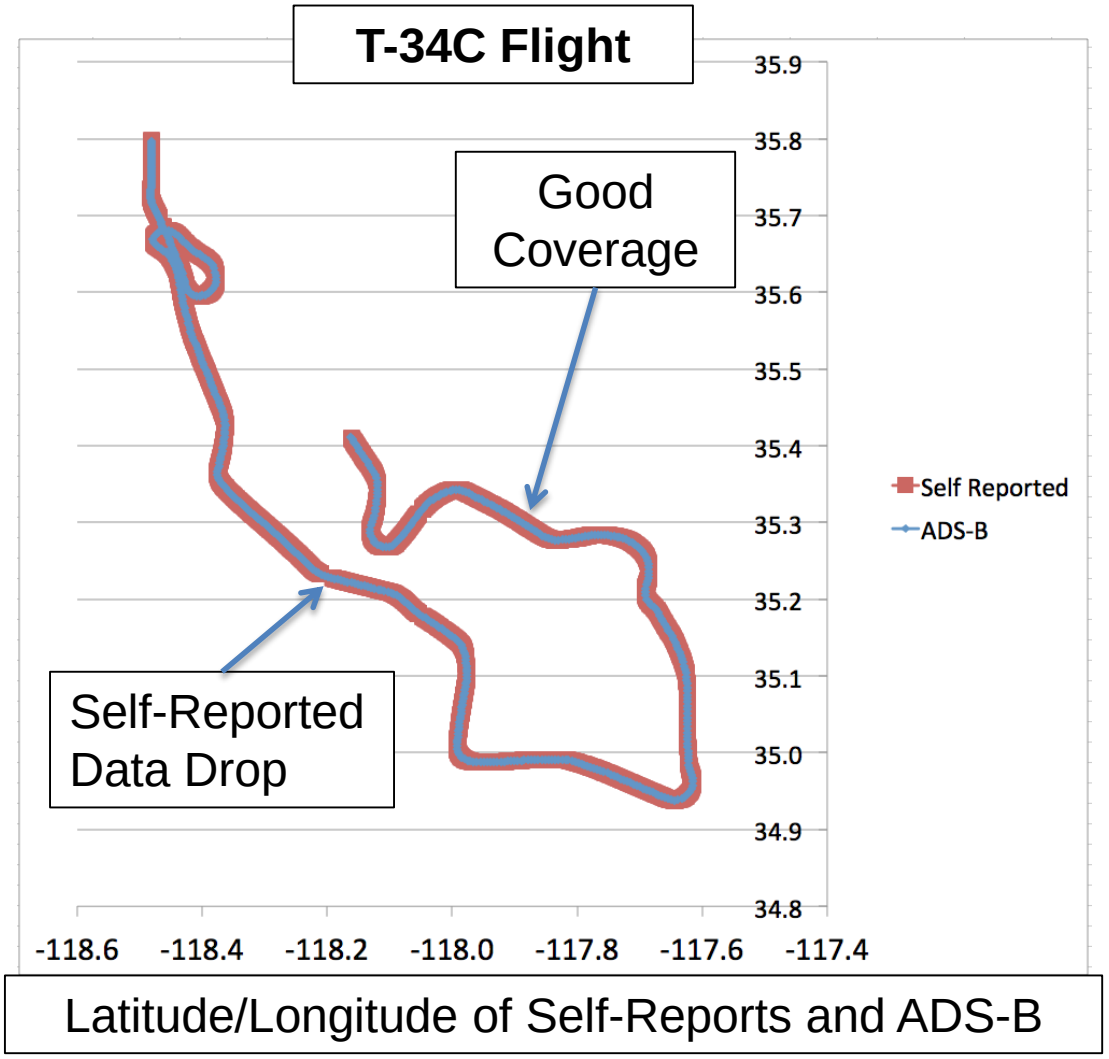
Display of NextGen data on LVC ATC Screen

Results: UAS-LVC Connections



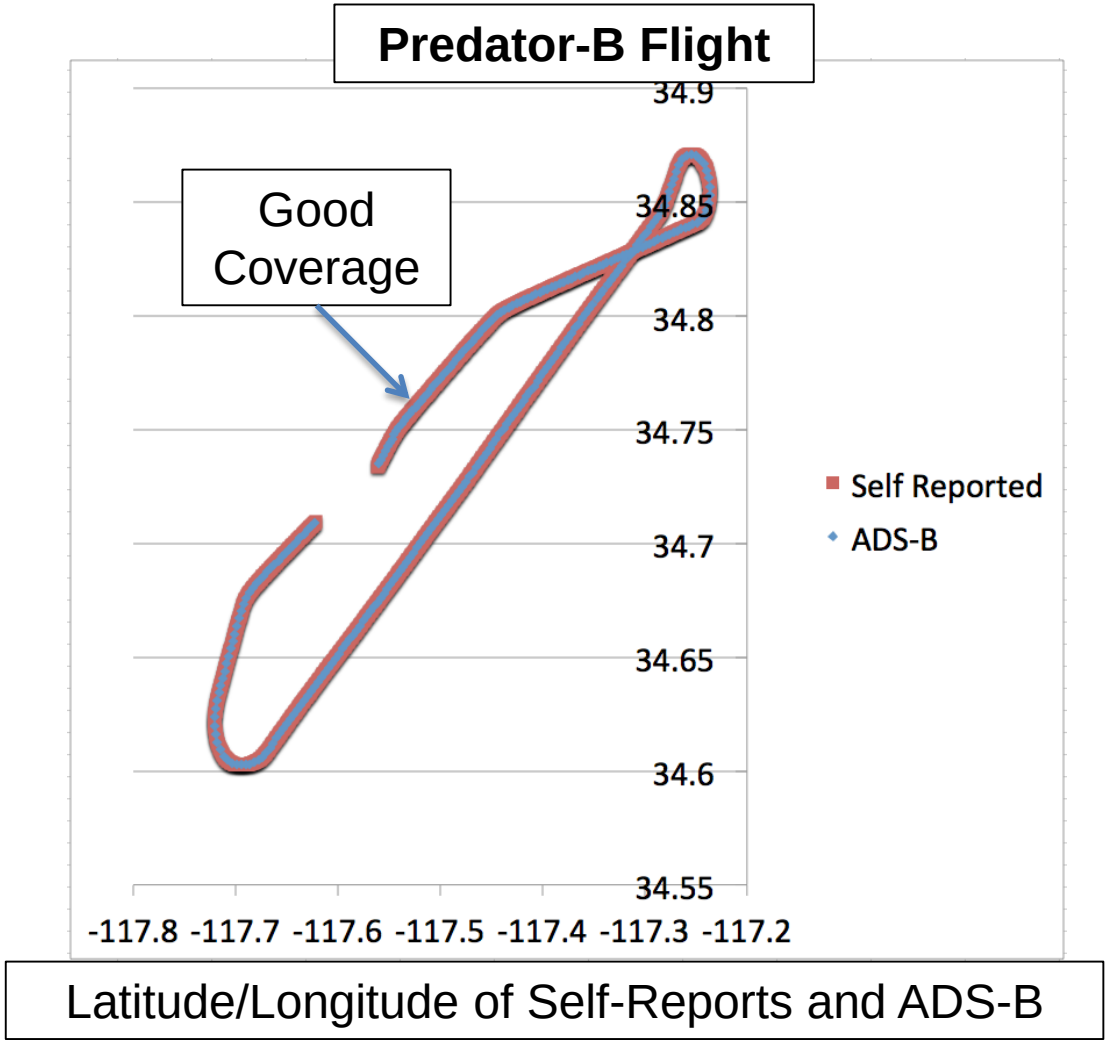
Results: Position Reporting

- 50 minute flight
  - Aircraft self-reports sent 2 times per second
  - ADS-B data recorded 1 every 5 seconds from commercial data sources



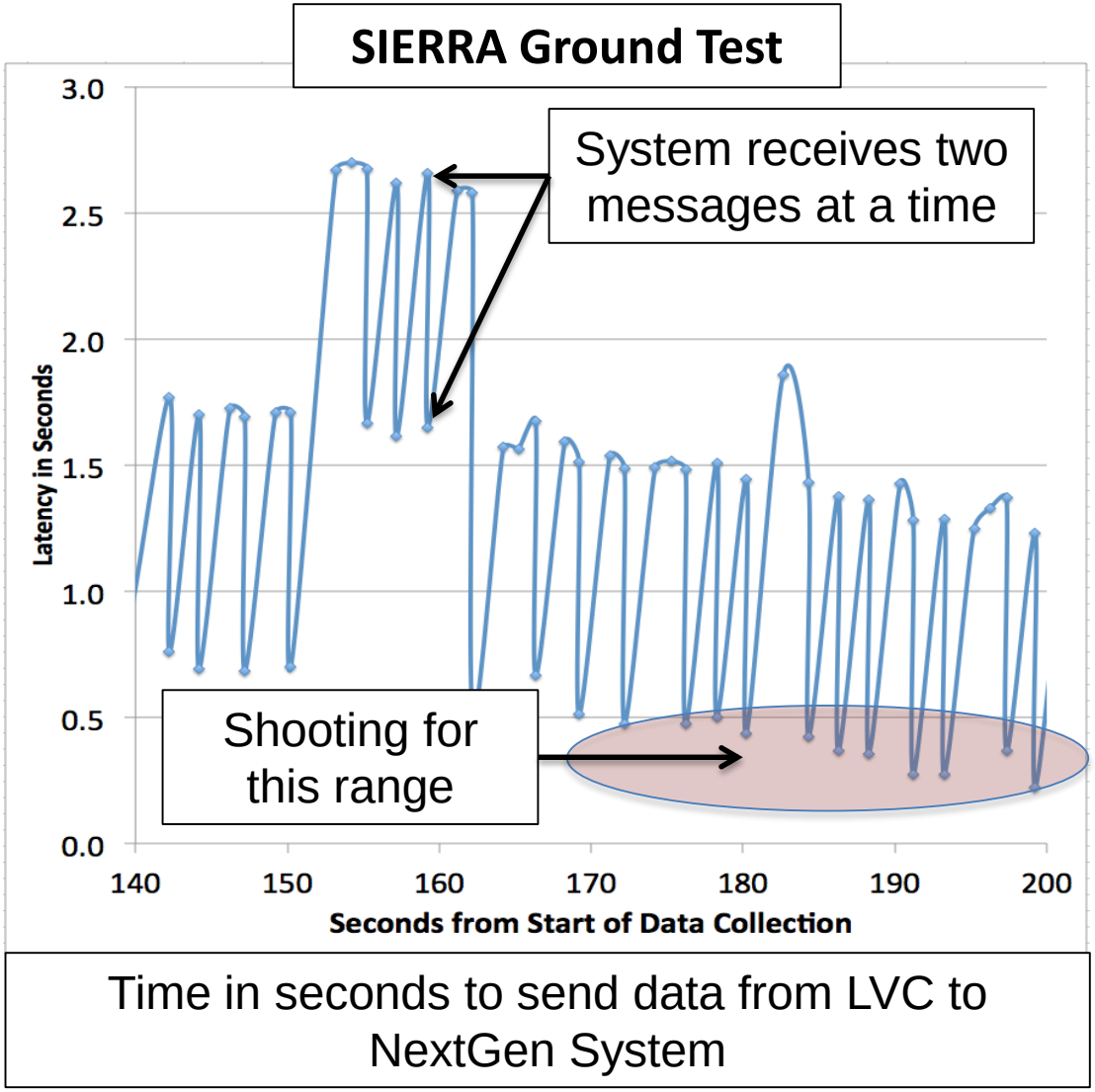
Results: Position Reporting

- 25 minute flight
  - Aircraft self-reports sent once per second
  - ADS-B data recorded 1 every 5 seconds from commercial data sources



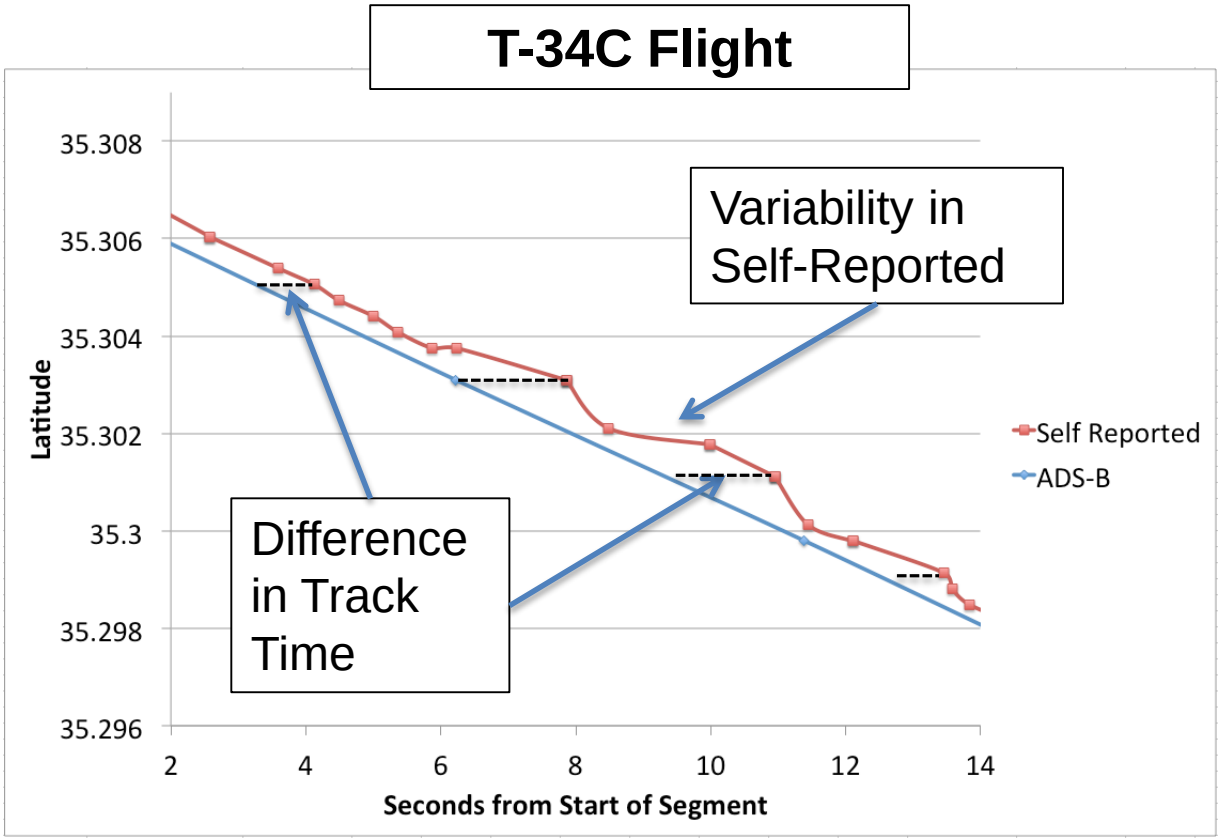
Results: Transmission Latency

- 3 minute test
  - Aircraft self-reports sent once per second
  - No ADS-B



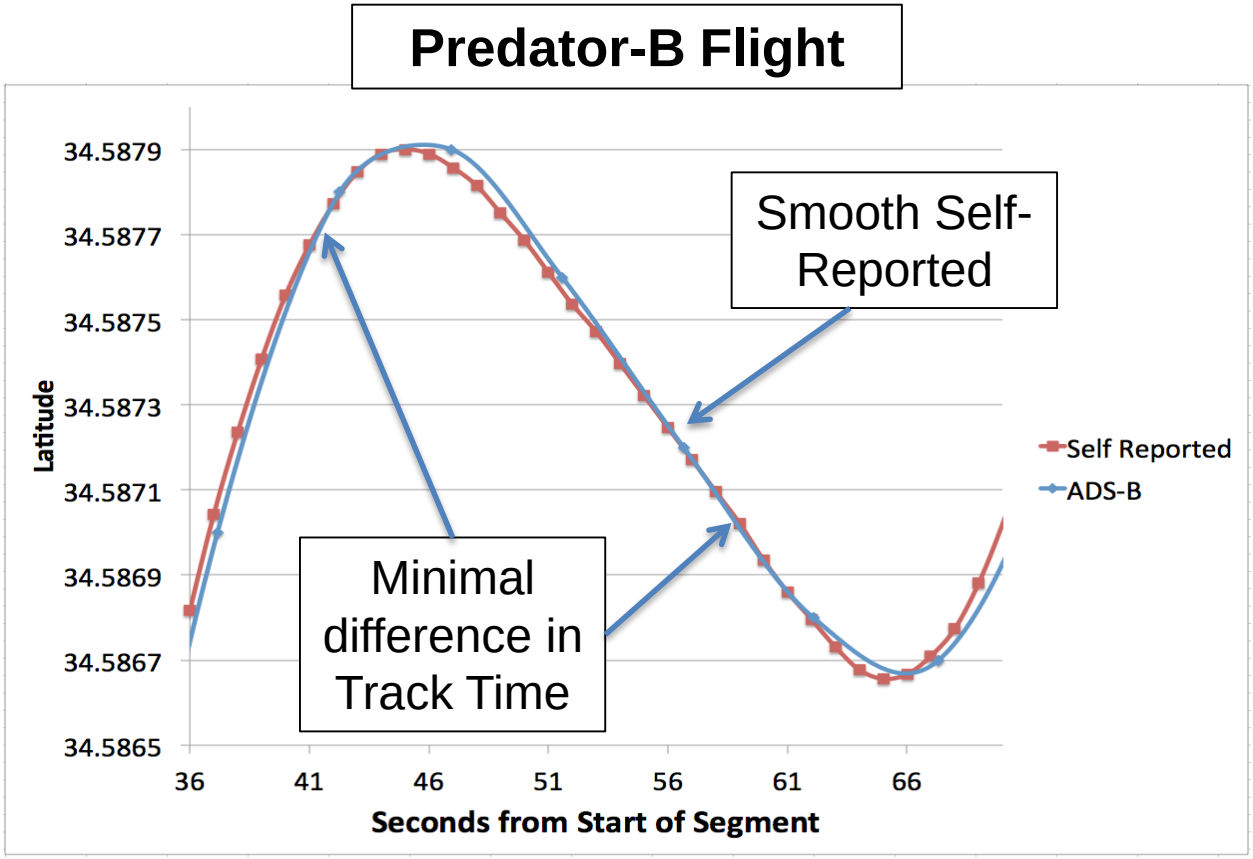
Time in seconds to send data from LVC to NextGen System

Results: Position Difference



- Self-report position/time recorded on board the aircraft
- ADS-B position/time comes from GPS receiver
- ADS-B appears to be slightly ahead of self-reported time
  - Average 800 ms earlier

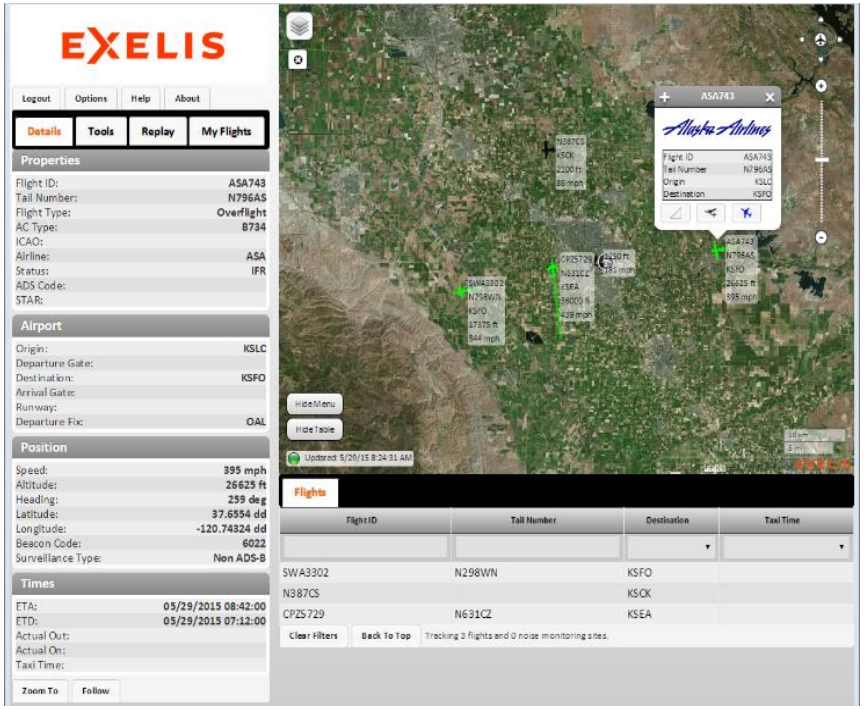
Results: Position Difference



- Self-reports position/time recorded on board the aircraft
- ADS-B position/time comes from GPS receiver
- ADS-B appears to be in line with self-reported time

Results: Display to GCS

Mobile display of traffic in Crow's Landing airspace provides situation awareness for pilots at Crow's landing during Unmanned Traffic Management (UTM) testing



Conclusions

- Equipment used for self-reported location has significant impact on aircraft position accuracy and utility
- Latencies added by system in line with commercial use
  - Need to address message buffering
- Viable to serve “TIS-B level” traffic awareness
  - Traffic Information Services – Broadcast (TIS-B)

Getting the Word Out

- Connection concept and technologies used during UTM flights
  - Display of traffic in test area for situation awareness
- Leveraged the GA/LVC connection in UAS-NAS Project flight testing
- Paper submitted to AIAA Aviation 2016 conference

Next Steps

- Flight Test with SIERRA
  - Scheduled for February
- Analyze self-reported position and time against high fidelity truth data
  - Investigate impact of different aircraft equipment
- Evaluate long-term LVC interface format
  - Address message buffering
- Use NextGen surveillance data in UAS flight test via the LVC connection